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Statement of

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Administrator

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

before the

Committee on Aeronautical and Space Sciences
United States Senate

Mr. Chairman and Members of the Committee:

Thank you for this opportunity to testify on the NASA authorization request for the nuclear propulsion program recommended by the President in his FY 1969 Budget. My appearance here today with Commissioner Ramey reflects the close working relationships that the National Aeronautics and Space Administration and the Atomic Energy Commission have in this program. As you know, the responsibilities of the two agencies for this work are carried out through our joint Space Nuclear Propulsion Office. We have a fully integrated program and an effective management arrangement for bringing to bear the capabilities of both agencies and those of industry and university groups associated with us, on the successful prosecution of the program.

It is extremely important for the United States to proceed with the development of nuclear rocket propulsion. We need the efficiency of nuclear power as a part of the nation's total capability in aeronautics and space. The four main points which emphasize this are:

<u>First</u>: During the second decade of the space age we will undoubtedly find that there are important civil or military requirements for space vehicles and missions requiring nuclear propulsion or for which it will provide decisive advantages.

<u>Second</u>: As in other fields of advanced technology, the nation should not short-sightedly cut off or constrain the development of new technology of great promise because specific requirements or applications cannot be clearly identified and justified in advance.

<u>Third</u>: It is very important that we move ahead with nuclear rocket engine development in FY 1968 and FY 1969 to give a clear signal that the United States does not intend to limit its development of large launch vehicle and payload capabilities to those of the Saturn V class space booster.

<u>Fourth</u>: It is important to proceed with the development of a nuclear rocket engine at this time to serve as a central focus for a continuing advance in the nuclear and other technologies involved. We may well find over the next half dozen

years important benefits and applications in other fields coming out of the work on nuclear propulsion, so much of which is at the most advanced boundaries of our current knowledge and technology.

In the past year, as in previous years, we have realized continued progress in the development of nuclear rocket propulsion. At the same time, our plans have been forced to undergo considerable change. Today, Commissioner Ramey and I will discuss briefly the highlights of this progress, and the nature of the changes in our plans. On subsequent days, Dr. Adams, Mr. Klein, Dr. Bradbury, and others will be here to testify on the details of these programs as you have requested.

We are all acutely aware of the present national budgetary situation and the need for strict expenditure limitations. The FY 1968 budgetary constraints and the continuing need to hold down expenditures in FY 1969 have, as you know, necessitated many reassessments and readjustments. In all our reappraisals, one of the foremost objectives has been to continue vigorous, meaningful near term progress while at the same time providing for some measure of progress toward the future capabilities necessary to provide a basis for leadership in space in the years ahead or, if this does not prove possible, a foundation from which we can use our great industrial capability to put under development and into production on a crash basis any systems essential to prevent our being denied the use of the space environment.

The development of the nuclear rocket engine has a unique place in our plans. Its high performance potential allows us to proceed with the development of a single engine which will provide the flexibility to accomplish a wide variety of future space missions. No other means of propulsion holds promise of providing so unique and efficient, but so flexible, a capability. The development of the nuclear rocket engine is, therefore, one of the most important measures we can take today to insure this nation the possibility of full realization of the many uses of space for years to come.

The approximately 75,000 pound thrust class nuclear rocket engine we are planning to develop could be used with the existing Saturn V vehicle in a third stage replacing the present chemical propulsion stage--the S-IVB-- for numerous missions. This replacement will approximately double the payload for many missions, such as solar probes, or automated Jupiter flybys. Alternatively, it can reduce trip time to distant portions of the solar system by large amounts--hundreds of days, in some cases. In addition, and of substantial importance, the nuclear rocket increases the performance for direct flights to the moon by about 65 percent and holds the promise of performing, with a very substantial payload, complex earth-orbital missions. These include ferry missions for maintenance or resupply of synchronous orbit satellites and large or multiple orbital plane changes for heavy payloads. Because of this flexibility and wide utility, the nuclear rocket engine is likely to be used in applications presently unforeseen as well as in the many ways we currently envision. But as important as any mission we can presently foresee, Mr. Chairman, is the advances that will be made in our ability to control and apply nuclear energy for space use, and the continuing active involvement of government, industry and university scientists and engineers in this critically important technology.

One of the most important factors supporting the decision to proceed with NERVA development now is that propulsion systems require such a long lead time for development before they become operationally useful. This means that the decision to initiate engine development must be made in anticipation of its future use even though specific future missions cannot be fully defined. For example, development of the F-1 engine for the Saturn V first stage was started three years before the decision was made to proceed with the Apollo program, and before the Saturn V was defined. The J-2 engine was also started in advance of mission definition. Because the nuclear rocket engine is being designed from the start for multiple uses in the space environment, it is important that we achieve high performance and reliability while building mission flexibility into its design. These stringent criteria result in lead times at least as long as for chemical engines. The successes of the nuclear propulsion technology program permit us to proceed with the development of this advanced performance system with confidence. In light of these considerations, we have decided to proceed with the development of a flight-qualified nuclear rocket engine for space application.

A year ago we had concluded from a study of the missions which we could foresee, and from the relative development costs of the various alternatives, that a 200,000 pound thrust engine provided the best performance for all of the missions considered, including earth-orbital, lunar, and manned planetary flight and other very large planetary payloads. Consistent with this conclusion, and with the policy of recommending the most able-bodied, capable technological advances within the state-of-the-art and reasonable fiscal possibilities at the time, we chose to propose development of a 200,000 pound-class NERVA engine.

This choice was affected, however, by the budgetary actions of the past year. For FY 1968, we had requested authorization and appropriation of $74 million for research and development, and $19.5 million for construction at the Nuclear Rocket Development Station in Nevada. The reductions of over $500 million in the total NASA budget made possible, in a balanced program, the allocation of only $54 million for nuclear rocket research and development and prevented initiation of construction.

In considering how best to move ahead within the overall budgetary constraints without causing a major hiatus in the development of nuclear propulsion, we concluded, as we informed the Committee last Fall, that a nuclear engine of approximately 75,000 pounds thrust would be the best system to proceed to develop. Our studies show that for all types of missions that we now foresee an engine in this class will provide performance gains approximately equal to those possible with the larger engine, except that it is not the optimum size for very large planetary flights such as manned planetary landing missions. However, Mr. Chairman, I want to be very clear that we are not proposing to proceed with nuclear engine development on the basis of manned flight to the planets and that such missions are not included in our plans at this time.

The lower thrust engine can be developed at a lower total cost and, particularly important, will require less funding in the next few years than the 200,000 pound thrust engine. The ability of the 75,000 pound thrust engine to use hardware of approximately the same kind and size as used in the KIWI-NERVA I development and test program now ending and to use the basic test facilities developed for that phase of the program are the primary reasons for these savings.

As I advised this Committee last November, in presenting the FY 1968 operating plan, we are preparing to proceed in FY 1968 with the development of this lower thrust nuclear engine as soon as Congressional action on our FY 1969 Budget clearly indicates that we will have support to continue in FY 1969. We are currently engaged in translating the accomplishments of the technology program into hardware designs for flight application. We have demonstrated many of the advanced technological goals that are required for a high-performance space engine. The nuclear reactor development efforts which recently resulted in a 60-minute full-power test of the NRX-A6 reactor permits us to project an initial specific impulse in the range of 825 seconds. We believe that it will be possible in the couse of development to increase the specific impulse of the engine with concomitant expansion of this space engine's usefulness and flexibility.

The nuclear rocket technology base has been systematically built in a series of steps starting with component and sub-system development and a progression of increasingly complex integral systems tests. These included cold flow engine testing and system testing of a "breadboard" engine. They will culminate with the next series of tests, for which preparation is now underway, the ground experimental engines designated XE-1 and XE-2. These engines will be fired downward in the NRDS facility, with which it is possible to simulate partially the vacuum environment of space. The goal of our flight engine development is to incorporate the best features of our current technology, both nuclear and chemical, in a highly reliable nuclear flight engine. Our program to accomplish this includes testing of the engine and of its components under the most stringent and demanding conditions. These efforts include a series of reactor and integrated engine tests to assure a completely flight ready engine which we can commit to the future tasks of our space program.

Concurrently with the engine development program we are continuing efforts to identify any new area of technology which might be required for future nuclear stage development. This work is carried out by the Marshall Space Flight Center in conjunction with industry and includes studies of space insulation for hydrogen tanks, radiation effects on space vehicles and hydrogen propellant handling techniques in space.

Through Fiscal Year 1968 we will have invested $1.139 billion in the nuclear rocket program, Mr. Chairman -- $444.8 million of NASA funds and $694.5 million by the AEC. This year the NASA authorization request totals $60 million. In the recently passed AEC authorization bill, Congress has approved $69 million of the $72 million AEC request for the nuclear rocket program.

As I have previously stated, progress in all areas of the program has been steady and satisfying and the nuclear rocket represents a unique and versatile propulsion capability. I believe this work should proceed and urge you to authorize the full amount recommended by the President.

In closing let me make one final point. Just as the nuclear propulsion program is clearly an essential part of a balanced and effective total space program, so is a balanced and effective total space program essential to justifying a decision to proceed with nuclear engine development and to provide for its ultimate use. At the total budget level of $4.37 billion recommended by the President for NASA for FY 1969, we have had to make many difficult decisions and many reductions. In my opinion we have approached the lower limits for an effective and balanced program. It is essential, I believe, to point out that if there should be a substantial reduction in the total NASA budget for

FY 1969 we will have to call into question once again the basic assumptions and balance on which that budget was based. We will have to carefully reconsider each main element of the total program, including the nuclear propulsion program, to see if we should proceed with it in the light of the reductions in our total budget. We attach very great importance to the development of nuclear propulsion, and I hope that this Committee and the Congress will not only support the nuclear propulsion program, but will approve a total NASA program which will make it possible for us to proceed with a balanced and effective program as recommended in the President's Budget.